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# Images in Health Surveillance: Tickborne Disease Vectors and Lyme Disease Clinical Diagnosis

Military members who live and train in the United States and abroad are at risk for tickborne diseases. Different tick species transmit different infectious agents and have varying geographic distributions. In the U.S. tickborne diseases include Lyme disease, Rocky Mountain spotted fever (RMSF), ehrlichiosis, anaplasmosis, Powassan virus encephalitis, babesiosis, and Colorado tick fever. Tick bites are also a mode of transmission for tularemia and Q fever.

Outbreaks of tickborne diseases follow seasonal patterns (generally April-September). Ticks are commonly found in wooded and brushy areas where they physically contact hosts. Service members are at risk of exposure to ticks while off-duty (e.g., landscaping, camping, hiking) as well as on-duty during training and operations. Prevention of tick bites (e.g., wearing long pants tucked into boots or high socks, repellent usage, bathing after possible exposure), full-body tick checks, and proper identification and removal of ticks are important measures to prevent tickborne disease.

## Epidemiologic/clinical features of Lyme disease

In the U.S., Lyme disease is the most commonly known and reported vector-borne disease. Although cases cluster in the north-eastern and north-central U.S., Lyme disease cases have been reported from nearly every state.<sup>1</sup> From 2001 to 2008, counts of Lyme disease among service members increased, particularly from 2006 to 2008; most cases were reported from installations in Lyme disease endemic areas of the U.S. and Europe.<sup>2</sup> In 2010, there were 208 cases of Lyme disease in active and reserve component military service members.<sup>3</sup>

*Borrelia burgdorferi*, a spirochete bacterium, is the causative agent of Lyme disease in the U.S. (Figure 1). During feeding, ticks infected with the spirochete pass them into the host. Generally, infected ticks must

**FIGURE 1.** Dark field microscopy of *Borrelia burgdorferi*



**FIGURE 2.** Erythema migrans in a Lyme disease patient



be attached for 36-48 hours to transmit the infection; therefore, prompt removal of embedded ticks is an effective preventive measure against Lyme disease.<sup>4</sup>

The classical clinical presentation of Lyme disease includes a “bulls-eye rash,” or erythema migrans (EM) (Figure 2). EM occurs in approximately 70-80 percent of infected persons.<sup>4</sup> Because the identification of EM on darker-skinned individuals can be difficult, infections may remain untreated longer in these individuals. Delays in treatment may contribute to the increased occurrence of Lyme-related arthritis among black, non-Hispanic compared to other racial/ethnic subgroup members.<sup>2,5</sup>

Other common signs and symptoms of Lyme disease are non-specific and include headache, muscle and joint pain, fatigue, nausea, and fever. Without effective antibiotic treatment, acute symptoms can persist and long-term pathologic effects – on joints (e.g., arthritis), the heart (e.g., conduction abnormalities), and the nervous system (e.g., peripheral facial palsy) – can occur.

## Tick vectors of Lyme disease

*Ixodes scapularis*, the blacklegged tick or deer tick, is distributed widely across the eastern half of the U.S. (Figure 3).<sup>4</sup> *Ixodes scapularis* is the primary vector of Lyme disease

and can also transmit anaplasmosis, ehrlichiosis, Powassan virus, and babesiosis.<sup>6-8</sup> Most humans are infected through the bites of immature ticks (nymphs) because they are small (less than 2mm) often go undetected; thus, they are less likely to be removed (see inset).<sup>4</sup> In general, nymphs of *Ixodes spp.* are approximately the size of a poppy seed (<2mm), and adult ticks are approximately the size of a sesame seed (2-3mm).<sup>6</sup>

*Ixodes pacificus*, the western black-legged tick, is found along the Pacific coast of the U.S. and transmits Lyme disease and anaplasmosis (Figure 4).<sup>4,6,7</sup>

## Tick vectors of Rocky Mountain Spotted Fever (RMSF) and other diseases

*Dermacentor variabilis*, the American dog tick or wood tick, is found in the eastern and central U.S. and in limited areas on the Pacific Coast (Figure 5).<sup>4</sup> It is the major vector of RMSF and can also transmit tularemia.<sup>7,9</sup> Adult *Dermacentor* species, the most common stage found feeding on humans, are approximately 4-5mm (see inset), making them larger and more readily detected than *Ixodes* species.

*Dermacentor andersoni*, the Rocky Mountain wood tick, is found in the western and northern U.S. and is a vector for RMSF, tularemia, Colorado tick fever, and Q fever (Figure 6).<sup>4,6,9</sup>

**FIGURE 3. *Ixodes scapularis***



CDC/James Gathany

**FIGURE 4. *Ixodes pacificus***



CDC/James Gathany

**FIGURE 5. *Dermacentor variabilis***



CDC/James Gathany

**FIGURE 6. *Dermacentor andersoni***



CDC/James Gathany

*Amblyomma americanum*, known as the lone star tick, is found primarily in the southeastern and southcentral U.S.; however, it is also widespread throughout the eastern half of the U.S. (Figure 7).<sup>4</sup> Females have a characteristic white star marking located centrally on the dorsal surface. *A.americanum* is a vector for ehrlichiosis and tularemia.<sup>7,9</sup> Similar to *Ixodes* species, the tiny nymph stage is the most common stage found feeding on humans. *Amblyomma* species are slightly larger than *Ixodes* species; adult females are approximately 3mm.

**FIGURE 7. *Amblyomma americanum***



CDC/James Gathany

## CONCLUSION

Reducing exposure to ticks through personal protective measures and prompt removal of attached ticks are the primary preventive measures for tickborne disease. Information regarding Lyme disease, (including instructions for tick removal) is available from the U.S. Army Public Health Command at: [http://phcamedd.army.mil/PHC%20Resource%20Library/18-028-0107-Tick-Borne\\_Diseases\[1\].pdf](http://phcamedd.army.mil/PHC%20Resource%20Library/18-028-0107-Tick-Borne_Diseases[1].pdf) and from the CDC at: <http://www.cdc.gov/lyme/>.

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